CLAIMS

What is claimed is:

1. A position sense interface for a micro-mechanical element, comprising:

at least a first and a second electrically decoupled sense capacitors; and

position detection circuitry comprising a differential charge integrator with input-sensed, output driven feedback.

2. The position sense interface of claim 1 wherein said integrator includes an operational amplifier having an input and an output, and an input sensing, output driving feedback circuit.

3. The position sense interface of claim 1 wherein said position detection circuitry operates over a first non-overlapping time period and a second non-overlapping time period.

4. The position sense interface of claim 2 wherein the feedback is common mode.

5. The position sense interface of claim 2 wherein the differential charge integrator senses common mode.

6. The position sense interface of claim 2 wherein the feedback is time multiplexed.

7. The position sense interface of claim 2 wherein the feedback is frequency multiplexed.

8. The position sense interface of claim 2 wherein the feedback is

continuous-time.

9. The position sense interface of claim 1 wherein each said sense capacitor comprises at least one proof mass.

10. The position sense interface of claim 1 wherein the micromechanical element comprises:

a substrate and at least one proof-mass; and

wherein said first and second electrically decoupled sense capacitors comprise four independent terminals, each electrically decoupled sense capacitor comprising an independent terminal on said proof mass, and an independent terminal on said substrate.

11. The position sense interface of claim 1 further including a compensating charge on each said sense capacitor.

12. The position sense interface of claim 1 wherein each said sense capacitor includes at least two independent terminals such that said first and second sense capacitors have four independent terminals.

13. The position sense interface of claim 1 further including a first and a second reference capacitor.

14. The position sense interface of claim 13 wherein said first and said second reference capacitor are substantially equal.

15. The position sense interface of claim 13 further including at least one binary weighted capacitor array in parallel with at least one reference capacitor.

16. The position sense interface of claim 13 wherein a charge is applied to said position detection circuitry by a changing voltage applied to said reference capacitors.

17. An integrated circuit formed on a semiconductor substrate, comprising:

a micromechanical structure formed in or on said substrate; and

a position detection circuit formed in and on said substrate, and including an operational amplifier and a negative feedback circuit.

Sub a1

18. The integrated circuit of claim 17 wherein said negative feedback circuit is an input-sensing, output driving feedback circuit.

19. The integrated circuit of claim 17 wherein said micromechanical structure includes a first proof mass and a second proof mass.

20. The integrated circuit of claim 19 wherein said first proof mass comprises a first sense capacitor and said second proof mass comprises a second sense capacitor.

21. The integrated circuit of claim 20 wherein said first and second sense capacitors are coupled in said feedback circuit.

22. The micromechanical system of claim 20 wherein said first proof mass and said second proof mass are connected so as to electrically decouple said sense capacitors.

23. The integrated circuit of claim 17 wherein said micromechanical structure includes:

a substrate;

at least one proof-mass; and

first and second electrically decoupled sense capacitors; and

wherein said first and second electrically decoupled sense capacitors comprise four independent terminals, each electrically decoupled sense capacitor comprising an independent terminal on said proof mass, and an independent terminal on said substrate.

Sub a1

24. The micromechanical system of claim 17 wherein said operational amplifier includes at least a first input, and a first signal applied to said feedback circuit places said operational amplifier in unity gain feedback during a first non-overlapping time period.

25. The micromechanical system of claim 17 wherein a second signal to said feedback circuit places said operational amplifier in a charge integration mode during a second non-overlapping time period.

26. A position sense interface, comprising:

an input-sensed, output-driven common mode feedback loop; and

a differential operational amplifier having an input.

27. The position sense interface of claim 26 further including a negative feedback loop responsive to a differential input at the input of said differential operational amplifier.

28. The position sense interface of claim 26 further including sense capacitors in said feedback loop.

29. The position sense interface of claim 28 wherein said sense capacitors are formed by at least one proof mass.

30. The position sense interface of claim 28 further including reference capacitors.

31. The position sense interface of claim 28 further including feedback coupling capacitors.

32. The position sense interface of claim 28 further including feedforward capacitors.

33. The position sense interface of claim 28 further including unity gain feedback switches.

34. The position sense interface of claim 33 wherein said operational amplifier includes at least a first input, and a first signal applied to said unity gain feedback switches places said operational amplifier in unity gain feedback during a first non-overlapping time period.

35. The position sense interface of claim 34 further including output zeroing switches, wherein a second signal to said output zeroing switches places said operational amplifier in charge integration mode during a second non-overlapping time period.

36. The position sense interface of claim 28 further including output zeroing switches.

37. The position sense interface of claim 26 wherein said feedback loop operates over two recurring, non-overlapping time periods.

38. The position sense interface of claim 28 wherein said feedback loop operates over two recurring, non-overlapping time periods and during said

second time period, substantially equal charge is applied to sense capacitors.

39. A micromechanical structure including a position sensing interface coupled to the micromechanical structure, comprising:

a substrate;

at least one proof mass connected to said substrate;

first and second sense capacitors formed by terminals located on said at least one proof mass and said substrate;

an operational amplifier; and

an input sensed, output driven, common mode feedback loop having an output,

wherein said common mode feedback loop is coupled to said operational amplifier and said first and second sense capacitors.

40. The microelectromechanical structure of claim 39 wherein said output is representative of acceleration applied to the micromechanical structure.

41. The microelectromechanical structure of claim 39 wherein said microelectromechanical structure comprises an accelerometer.

42. A microelectromechanical structure comprising:

a substrate;

a suspension;

at least one proof mass connected to said substrate by said suspension;

a first terminal attached to said proof mass;

a second terminal attached to said proof mass, and electrically isolated from said first terminal;

a third terminal attached to said substrate; and

a fourth terminal attached to said substrate;

wherein said first terminal and said third terminal form electrodes of a first capacitor, and said second and said fourth terminals form electrodes of a second capacitor.

43. The microelectromechanical structure of claim 42 wherein said first and second terminals are mechanically attached to said proof-mass, and electrically isolated from each other by at least one dielectrically-lined isolation trench.

44. The microelectromechanical structure of claim 42 wherein said suspension comprises an electrical connection to said first terminal.

45. The microelectromechanical structure of claim 42 wherein said suspension further comprises:

a first conductive beam; and

a second conductive beam;

wherein said first conductive beam is electrically connected to said first terminal and second conductive beam is electrically connected to said second terminal.

46. The microelectromechanical structure of claim 42 wherein said proof-mass is formed of silicon.